

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
PATENT APPLICATION**

|              |   |                     |                       |
|--------------|---|---------------------|-----------------------|
| Appl. No.    | : | 10/679,787          | Confirmation No. 3730 |
| Applicant    | : | Kejun Zeng          |                       |
| Filed        | : | October 6, 2003     |                       |
| TC/A.U.      | : | 1725                |                       |
| Examiner     | : | Johnson, Jonathan J |                       |
|              |   |                     |                       |
| Docket No.   | : | TI-36531            |                       |
| Customer No. | : | 23494               |                       |

**AMENDED BRIEF ON APPEAL**

M. S. Appeal Brief-Patents  
Commissioner for Patents  
P. O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

In support of his appeal of the Final Rejection of claims in this application, applicant respectfully submits this brief.

**REAL PARTY IN INTEREST**

The real party in interest is Texas Instruments Incorporated, a Delaware corporation with offices at 7839 Churchill Way, Dallas, Texas 75251.

**RELATED APPEALS AND INTERFERENCES**

There are no known related appeals or interferences.

**STATUS OF CLAIMS**

This is an appeal of claims 32 and 33, all of the rejected claims. Claims 1-31 were canceled from the current examination. No claim is allowed.

## **STATUS OF AMENDMENTS**

Appellant did not file an amendment in response to the final rejection of February 13, 2006.

## **SUMMARY OF CLAIMED SUBJECT MATTER**

The claims direct to a solder joint structure for a semiconductor apparatus. Claim 32 is an independent claim. Claim 33 depends from claim 32.

### **Claim 32**

Claim 32 directs to a solder joint structure, one embodiment of this claimed invention is depicted in Figure 2B of this application. The structure has a two layered copper structure (14, 22) with the top layer being about 0.6  $\mu\text{m}$ ; a nickel layer (20) is sandwiched between and contacts the two copper layers (14, 22); and a solder ball (16) sits on and contacts the top copper layer (22).

The two layered copper structure is described in the specification on page 5, paragraph [021], lines 1-6 – Cu pad (14) is the bottom copper layer and layer (22) is the top copper layer; the thickness of the top layer being about 0.6  $\mu\text{m}$  is described in page 6, line 5; the nickel layer (20) is described in page 5, paragraph [021], lines 4-5; the relative position of the nickel layer to the two copper layers is depicted in Figures 2A and 2B; and the solder ball (16) is described in page 5, bridging page 6, paragraph [021], lines 8-9.

### **Claim 33**

Claim 33 directs to the solder joint structure of claim 32 with one additional component – a layer of  $\text{Cu}_6\text{Sn}_5$  (18), which is derived from the top copper layer and the solder ball.

The layer of  $\text{Cu}_6\text{Sn}_5$  (18) is described in the specification page 3, paragraph [008] and paragraph [012].

## **GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 6,180,265 (Erickson) in view of US 6,445,069 (Ling).

## **ARGUMENTS**

- 1. The 103(a) rejection is improper because the references cited in the Office Action fail to provide suggestion, incentive, or motivation to combine the teachings suggested in the Office Action.**

Applicant respectfully submits that the 103(a) rejection against claim 32 is improper because the Office Action fails to establish a prima facie case of obviousness.

Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over US 6,180,265 (Erickson) in view of US 6,445,069 (Ling).

The Office Action suggests that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the pad material in Erickson to utilize copper in order to provide better thermal conductivity as motivation to combine the teachings of the prior art. The cited references, however, do not support this suggestion.

First, as quoted in the Office Action, a 35 U.S.C. 103(a) rejection is only proper when “the subject matter sought to be patented and the prior art such that the subject matter as a whole would have been obvious....”

Claim 32 describes a solder joint structure for a semiconductor apparatus that has a two-layered copper structure; the Erickson patent discloses a method to form solder bump pad on an aluminum wire bond pad. The Erickson method involves depositing a nickel layer on the aluminum pad to protect it from oxidation and then depositing a solderable material – copper – on the nickel layer. Had a person skilled in the art replaced the aluminum pad with a copper pad, as suggested in the Office Action, then the solderability would have been realized, without the additional nickel layer and the top copper layer. In other words, a simple copper pad would have achieved both the desired solderability and the “better thermal conductivity”; instead of a two-layered copper structure, as required in claim 32 of this application.

- 2. The 103(a) rejection is improper because a combination of the teachings in the references cited in the Office Action would destroy the intent of the invention disclosed.**

Second, it is well established that a §103 rejection based upon a modification of a reference that destroys the intent, purpose or function of the invention disclosed

in the reference, is not proper and the prima facie case of obviousness cannot be properly made.<sup>1</sup>

The intent of the Erickson patent, according to its abstract, is to convert a wire bond pad of a surface-mount IC device to a flip chip solder bump pad such that the IC device can be flip-chip mounted to a substrate. It is well known in the IC packaging art that aluminum bond pad is suitable for wire bonding because aluminum bond pad and gold wire form stable intermetallic compound and the oxide layer formed on the aluminum bond pad is easily removed by the ultrasonic scrubbing during the wire-bonding operation. On the other hand, copper bond pads are difficult for wire-bonding because the oxide layer formed on copper does not break up during wire-bonding and reliable wire-bonds are difficult to make. That is the reason an aluminum cap is usually placed on a copper pad if the IC device is to be wire-bonded.

Therefore, to replace the aluminum bond pad in the Erickson reference with a copper pad as suggested in the Office Action would have destroyed the intent of the Erickson patent because the pad would no longer be a “wire bond pad” as intended.

**3. The 103(a) rejection is improper because the references cited in the Office Action fail to recognize the problem solved in the invention.**

Third, it is well established that “a patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the “subject matter as a whole” which should always be considered in determining the obviousness of an invention under 35 U.S.C. §103.”<sup>2</sup> The invention described in claim 32 is to reduce the formation of Kirkendall voids at the surface of the copper bond pad, thereby promoting the reliability of the semiconductor devices. The nickel layer is to reduce the out-diffusion of the copper atoms from the top surface of the bottom copper pad where the formation of excessive Kirkendall voids tends to degrade the reliability of the IC devices. This problem is clearly explained in the original specification of this application<sup>3</sup> but is not recognized in either the Erickson reference or the Ling reference.

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<sup>1</sup> See, e.g., *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

<sup>2</sup> *In re Peehs*, 612 F.2d 1287, 204 USPQ 835 (CCPA 1980).

<sup>3</sup> See, e.g., paragraphs [022] and [023] of this application.

In summary, applicant respectfully submits that because the references cited in the Office Action fail to provide suggestion, incentive, or motivation to combine the teachings suggested in the Office Action; the primary reference even teaches away from the suggested combination; and none of the references recognizes the problem the invention in claim 32 is intended to solve, the Office Action does not establish a prima facie case of obviousness against claim 32, and claim 32 stands patentable over the references.

### **Conclusion**

Applicant respectfully submits that claim 32 stands patentable because the Office Action fails to establish a prima facie obviousness against claim 32:

1. The references do not provide any suggestion, incentive, or motivation to combine the teaching of the cited references;
2. The combination of the two references destroys the intent and the purpose of the invention in the reference; and
3. The references do not recognize the problem the invention in claim 32 intends to solve.

Because claim 33 properly depends from patentable claim 32, it also stands patentable at least by virtue of its dependence.

Applicant respectfully requests the Board to reverse the final rejection and allow the claims on appeal.

Respectfully submitted,

/Yingsheng Tung/

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## **CLAIMS APPENDIX**

The claims on appeal read as follows:

32. A solder joint structure for a semiconductor apparatus having a top surface, comprising:

a two-layered copper structure at the top surface of the semiconductor apparatus, having a bottom layer and a top layer, the top layer about 0.6  $\mu\text{m}$  thick;

a nickel layer sandwiched between and contacting the two copper layers; and

a solder ball formed on and contacting the about 0.6  $\mu\text{m}$  thick copper layer.

33. The solder joint structure claim 32, further comprising a layer of  $\text{Cu}_6\text{Sn}_5$  formed during a reflow process, in which the copper is derived from the 0.6  $\mu\text{m}$  thick copper layer and the tin is derived from the solder ball.

## **EVIDENCE APPENDIX**

None



**RELATED PROCEEDINGS APPENDIX**

None